



Retrospective Evaluation of the Protocol for US Army Corps of Engineers Aquatic Ecosystem Restoration Projects Part 2: Database Content and Data Entry Guidelines

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PURPOSE: This Technical Note was developed as a supplement to the Retrospective Evaluation of Corps Aquatic Ecosystem Restoration Projects Protocol Part 1: Project Overview. Objectives of this supplement are as follows: (1) describe the project-specific data entry and review procedures; (2) explain the various database components; (3) outline included datafields and datasets; and (4) document the process of developing the database.

DATABASE GUIDELINES: The outline that follows should be used in developing and populating databases for aquatic ecosystem restoration projects.

I. General Information¹

1. Ecosystem Type (Appendix A).
 - a. Specific habitat type. Enter habitat types as described in project documentation. Common types that emerge can later be developed into a checklist (after substantially more data have been entered).
2. Congressional Authority (Appendix B).
 - a. 1135 Project being modified.
 - b. Specific authorization.
3. P2 Number (if available).
4. Location.
 - a. State.
 - b. County.
 - c. Nearest city or town.
 - d. Corps Division – District.
 - e. Congressional District.
 - f. Lat-Long: Good source is Google Earth.
 - g. USGS Topo Quad: (1:24K, 7.5") Quadrangle name(s) and code number(s).

¹ Roman numerals correspond to labels in the aquatic ecosystem restoration project databases.

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- h. HUC: 8-digit hydrologic name(s) and unit code(s).
 - i. Watershed: Water body in which the project is located; generally scaled up to the next level.
- 5. Project Size.
 - a. Project area. Defines the project boundaries; equal to or larger than the project footprint/restoration area. This should be recorded in acres. If acres are not specified in the project documentation, use the GoogleEarth polygon function to outline the project area as specified in the project documentation to obtain the acreage.
 - b. Restoration area. Generally this will be the actual project footprint (the area directly affected by the restoration actions). In some cases, this will be the same as the project area.
- 6. Cost. Do not leave this field blank. If data are unavailable, enter "No data." Note: more detail will be developed separately and added to the database after project completion information is obtained and verified. This will include costs in each phase of the project – e.g., Reconnaissance, Feasibility, Design, Construction, Monitoring, and Adaptive Management.
 - a. Federal share.
 - b. Non-Federal share.
 - c. Total cost.
- 7. Timeline. Provide month and year, if possible. Definitions are intended as a general guide and are adapted from the Civil Works current P2 milestones listing.
 - a. Study start date. Date for the initiation of the Study after funds have been received.
 - b. Study end date. Date when planning, engineering, and design are completed. In effect, the date for completion of the approval process of the plans and specs, including internal technical review and certification.
 - c. Construction start date. Date of the start of actual construction or the "turn dirt" date after notice to proceed.
 - d. Construction physically complete date. Finish date for all physical contract work, including punch list deficiencies.
 - e. Date turned over to sponsor. Essentially the Notice of Project Completion/ Turnover – the date that the District Engineer notifies the project sponsor in writing that the project is complete and furnishes the non-Federal sponsor with an interim or final operations and maintenance (O&M) manual.
- 8. Corps Point of Contact. Project manager, Corps District.

II. Project Overview

Note: It will often be possible to cut and paste relevant information from different parts of the documents being reviewed. When doing this, it is critical to review and edit the material to economize on words and delete references to other parts of the original document that are not relevant to the database. (Copy relevant data from project reports

and paste into a Word document. Edit as appropriate, then copy and paste each response from Word to the appropriate paragraph.) Also, the same material may be stated and restated in project documentation in slightly different ways. In these cases, one should attempt to capture the most salient points, sometimes drawing on and summarizing material from different parts of the same or different documents. Indicated word limits are loosely defined, not hard and fast.

1. Project Purpose. 100 words or less. Occasionally, a lot of details are provided on specific performance objectives. These should be succinctly summarized to the extent possible. There should be some linkage with two other sections: (1) performance objectives, if specified, may also be captured in “Success Criteria,” and (2) purpose should also be evident in “Restoration Intent.”
2. Problem Description. 100 words or less. There should be an obvious link between the problem description and the “Environmental Resource Issues” sections that follow.
3. Environmental Resource Issues (Appendix C). These should be major environmental resource issues related to the project; the number can vary from one to many. Generally, environmental resource issues will be clearly stated as such in project documentation. There should also be an obvious linkage to the project purpose, problem or site description, and/or project features. Users should not infer issues where a specific resource is mentioned in passing, e.g., when a threatened and endangered (T&E) species is considered a transient in the area. Users also should not be limited by the pick list provided, and should not try to force an item to fit under one of the existing categories. The pick list is only a starter list. It may be appropriate to add other key words and phrases.
4. Project Site Description. 100 words or less; a verbal description of the location and major features of the site prior to restoration.
5. Project Features. Less than 150 words; this section summarizes the major restoration and engineering features. More detail, especially technical detail, will be warranted here to cover and clearly portray the range of features applied. It will sometimes be difficult to determine what should and what should not be included in this section. In these cases, it may be helpful to go to the original documentation for pertinent details.
6. Resource Significance (Appendix D). The fundamental question in creating this appendix is “What is significant about this project that warrants the federal investment?” Generally, this should be clearly discernible from project documentation. This section should particularly focus on national and regional significance. It should not be overly inclusive or infer beyond what is clear from the documentation. For example, potential or transient occurrence of an endangered species is not notable here.
7. Watershed Context.
 - a. Watershed assessment. If performed, it will have been clearly stated.
 - b. Watershed plan. If completed, it will be clearly stated and should be available as a document.
 - c. Dominant land use (Appendix E). If available, this information should be identifiable from the site description or material in the report. It won’t often show

up as a specific category of information in the report. It can sometimes be inferred from Google Earth. As a general guide, a dominant land use would be anything more than ~30% of local land-use activities.

- d. Land-use concerns. Watershed-scale and surrounding land-use issues that may affect the project.

III. Partners (Appendix F)

1. Project Sponsor. The project sponsor should be clearly evident by virtue of a formal agreement or statutory requirement; the sponsor often provides funding; there may be more than one project sponsor.
2. Project Partners. Project partners include any group identified as a project partner or participant; partners may have been involved in advocating for or planning the project, assisting with implementation, monitoring, etc. A partner is distinguished from a stakeholder in that the partner takes an active role in the project. For Federal partners, acronym abbreviations will be used (e.g., USGS, NOAA, USFWS, etc...). Federal agencies within larger departments such as National Marine Fisheries Service from NOAA will be listed as follows: NOAA–NMFS. Acronyms will also be used for some national-level NGOs (e.g., TNC, DU, etc...). (Note: An acronym list will be compiled and included at a later date.)
3. Project Stakeholders. A stakeholder is an entity or individual that may be affected by the project, but is not actively engaged in the project.

IV. Project Planning

1. Restoration Intent (Appendix G). Select one or more restoration intent from the list of alternatives. Intent should capture only what is stated as a goal/objective/purpose in source documentation. Do not infer intent; and do not interpret restoration actions as intent. It may be difficult, particularly when categorizing longer documents, to avoid this subjectivity. When you are reading a long document (more than a one-paragraph project description), only use sections that explicitly describe objectives, goals, purposes, intents; do not read the full document and then attempt to summarize the purpose yourself. Some projects will require multiple selections because of overlapping categories (e.g., some dam removals are for fish passage, some dam outlet retrofits are for water-quality management). If the project intent is impossible to classify in one of the categories provided, select “other” and type in the intent as written in the documentation. If a sufficient number of cases fall into a new category, that category will be added to the official database.
2. Planning Constraints. Typically, planning constraints will be clearly articulated in project documentation; e.g., “tidal exchange limited by the need to avoid additional flood risk to surrounding properties.”
3. Preparation of Conceptual Model. Creation of a conceptual ecological model (CEM) generally consists of determining system parts, choosing relationships linking these parts, specifying mechanisms by which parts interact, identifying missing information, and exploring model behavior. Completion of a formal CEM during project planning will provide either a narrative, tabular, or schematic description of

the project and identify project-specific attributes and corresponding performance measures. It is reasonable to expect that many restoration projects were conceived with a concept of how the system works. The critical issue is the nature and extent of documentation. To qualify under this section, the nature and extent of documentation need to be clearly stated. A CEM should go into some detail to present information or hypotheses on system components and interactions that are relevant to proposed restoration measures and ecological design.

Conceptual model types include narrative, tabular, and schematic; users can choose one or many—all three might be included; e.g., a schematic form is likely to be accompanied by a narrative description and might or might not include tabular information. Add a check-box selection for (1) Narrative; (2) Tabular; and (3) Schematic.

4. Planning Model Types Used. (Appendix H). This category includes any model or analytical tool used in project planning, especially in evaluating alternatives. This category also includes the specific model used and whether it was a newly developed or existing model.
5. Guiding Image/Reference State (Appendix I). This category indicates whether ecologically relevant desired conditions were identified in project planning; typically this would involve reference sites or conditions, although there could be other approaches. Typically the process of selecting and defining reference conditions occurs during the planning process, potentially in the context of conceptual modeling, and in conjunction with development of monitoring plans.
6. Project Work Group Utilized. This category of information might vary quite a bit regarding the level of engagement; it is better to be inclusive in creating this category. Various types of project work groups could exist and may be identified as task force and/or coordination groups or meeting participants. The subheading “Role of project work group” will address the level of engagement.

V. Restoration Measures and Engineering

1. Restoration Practices Employed (Appendix J). Several measures are likely to be employed on any given project; some may need to be added to the list. The list of restoration practices employed should correspond to material presented in the **“Project Features”** section. **NOTE:** If there is no documentation to determine the restoration practices employed, this section can be completed based on the planning reports. In these cases, the following note should be added to the “Implemented as planned and designed” text box: “No data available on restoration practices implemented, request information/documentation from the district.” If the restoration practices employed can be determined from a Project Fact Sheet, complete this section and include the following note in the “Implemented as planned and designed” text box: “Project Fact Sheet was utilized to determine the restoration practices implemented, request confirmation/documentation from the district.”
2. Describe Notable Project Engineering and Design Issues or Constraints. Approximately 50 words or less. This category of information is defined as including

a priori issues or constraints. Such issues or constraints are typically identified or faced in the engineering and design phase prior to implementation/construction.

3. Implemented as Planned and Designed. This category of information should be obvious in the documentation (O&M manual in particular).

If the response to this category is “no,” the significant change must be described. The description should be fairly brief, 25 words or less, and should include the significant changes and causes or reasons necessitating the change.

VI. Project Monitoring

1. Is There a Monitoring Plan? This could be a stand-alone plan, or it could be part of another document (e.g., Environmental Assessment). In either event, there would be a report or section of a document dedicated to monitoring. To qualify, it should include or provide reasonable reference to specific attributes to be assessed and metrics to be enumerated or calculated; ideally, methods would be included as well, but may not include details. Different types of monitoring may be included, as described below.
 - a. Implementation monitoring. Monitoring to assess whether the agreed-upon restoration actions were carried out; addresses whether project features were implemented as planned.
 - b. Effectiveness monitoring. Monitoring to determine if the restoration measures and features were successful in meeting the stated goals and objectives.
2. QA/QC Plan. If one exists, it will be clearly labeled as such; there is no basis for inference. The QA/QC Plan is a formal explanation of the steps to be taken to ensure the quality of the data and information to be gathered; the plan covers data acquisition, handling, storage, synthesis, and analysis.
3. Is There a Monitoring Report? Simple yes/no response.
4. Are Monitoring Data Available?
 - a. Pre-construction. Simple yes/no response.
 - b. Post-construction. Simple yes/no response.
5. Number of Site Visits Post Construction/Implementation. Select one of the given ranges.
 - a. Date of most recent site visit. This would be the last documented site visit; enter month and year if possible; year at a minimum.
 - b. What agency completed the most recent site visit? Generally this is going to be the Corps, the cost-share sponsor, and/or other partners (for partners, list those involved in the most recent site visit.)
6. Identify and Describe Monitoring Constraints. This category would include anything limiting the scope, nature, and extent of data and information acquisition (further defined as a priori constraints, typically identified during the development of monitoring plans or programs).
7. Have There Been Any Changes to the Monitoring Plan or Program?
 - a. Simple yes/no response.

- b. If yes, describe the changes made and why: 100 words or less. These would be changes identified during implementation of monitoring plans and programs.
8. Performance table. Any specifically listed monitoring metric is to be entered into the performance table. Water quality components (D.O., salinity, turbidity, etc...) with specific performance targets are listed separately. However, water quality in general is listed as a monitoring metric on its own or as it relates to the aspects of water quality without performance targets (e.g., improve water quality). This section should also include all monitoring aspects regardless of the availability of data to complete the performance target component. If no performance targets are present, simply leave that section of the table blank.
 - a. Data type. Biological, chemical, geomorphic, hydrological.
 - b. Monitoring metrics. This covers the general types of data to be collected and the units of measure to be used (e.g., % cover, concentration, abundance, density, rates, etc.).
 - c. Performance target. What is the specific performance target, endpoint, or range for each metric? If no performance target(s) are specified in the project documentation, enter "Not Specified" into the Performance table. [Note: This information will eventually be reported in a more easily visualized tabular form (see Appendix K for a sample).]

VII. Project Evaluation

1. Anticipated Benefits/Success Criteria. A verbal description in 100 words or less that should be as quantitative as possible (e.g., acres of specific habitats, miles of stream, acre-feet of aquatic habitat, number of specific species, etc.). Anticipated benefits/success criteria should be stated as outcomes rather than actions. The goal is to determine whether the project established and achieved ecological outcomes, not whether it was successful in implementing the planned project features. For example, herbicide application to 39 acres of a lake to remove an invasive species is an action; measurably enhancing 39 acres of an aquatic plant community is an outcome. The latter is the benefit and a reasonable criterion for gauging success. This is analogous to the difference between implementation monitoring and effectiveness monitoring; i.e., did researchers do what they said they were going to do versus did researchers' actions result in a desired ecological outcome.
2. Are Quantitative Success Criteria Identified? Simple yes/no response (a "yes" answer requires that at least one criterion be stated quantitatively).
3. Was the Project Successful in Achieving the Success Criteria/Goals? Possible responses are: Yes, Partially, No, ND [unable to determine]. The response should be based on a clear determination stated in the project documentation (e.g., monitoring report, O&M reports, site inspection reports, etc.). Users should not make a determination based on their own opinion. (For general purposes, "Yes" is viewed as mostly [$> 80\%$] successful; "No" is viewed as mostly unsuccessful [$< 20\%$ successful]; and "Partially" is viewed as anywhere in between. These are not hard thresholds, as data are not generally reported in this manner; the purpose of this

determination is to recognize that few projects will be a total success or a total failure.)

- a. Assessment method. Possible responses are: Expert Opinion, Field Data Collection, Modeling, Other (Specify), ND (unable to determine).
- b. Explain and cite source. Explain the basis for this determination. Note if and where the basis is explicitly documented. It is rare for a project to be totally successful or totally unsuccessful, so this response provides an opportunity to explain why the project may be less than fully successful. Success may be limited by any number of unforeseen events that should be identified here. Also, it may take several years for a project to become fully successful. If a project is on a trajectory for eventual success, that should also be noted here.

VIII. Adaptive Management

1. Was an Adaptive Management Plan Prepared? Simple yes/no response (intended to also include adaptive management reports).
2. Was an Operation and Maintenance Manual Prepared? Simple yes/no response.
3. Major Elements of Uncertainty in the Project: Include only those noted in project documentation. Do not infer areas of uncertainty.
 - a. Was monitoring designed to address uncertainty. Simple yes/no response.
 - b. If yes, this likely will have been identified in monitoring plans or reports and adaptive management plans.
4. Monitoring Results are Intended to Assess Project Performance.
 - a. Simple yes/no response.
 - b. If yes, recommendations provided/reported: Simple yes/no response.
5. Have There Been Post-Implementation Modifications to the Project Features? Simple yes/no response.
 - a. If yes, describe the modifications.
 - b. When was the modification implemented?
 - c. What were the additional costs?
6. Who Does Maintenance and Adaptive Management? If not the Corps, list the agencies involved.
7. Notable Innovations and Lessons Learned. Monitoring or other inspection reports may include sections that directly address lessons learned. The project might also represent a novel application of an existing technique/tool, development of a novel approach, or other unique situation worthy of note. Any of these should be included here.

IX. District Project Review

This section was developed to provide district project managers with an opportunity to provide input on the project, especially with respect to project outcomes and lessons learned. The District Review Protocol (**Appendix L**) was written to explain the

retrospective study and provide instructions to complete a District Review Survey (**Appendix M**) for each project included in the database.

1. Project Outcomes. Approximately 150 words or less; a verbal description of what has been accomplished. District Managers should comment on the outcome of each project from their district.
2. Score Overall Project Success. Score the project (1-5); see scoring definitions in the table below. To what extent were the desired habitat or ecosystem properties restored?
3. Explain Overall Score. A verbal description in 150 words or less from the Project Manager(s) of the determining factors that led to the score given above for Overall Project Success.
4. Notable Innovations and Lessons Learned. Innovations and lessons learned are documented independently above. This category is intended to capture the District's perspective of the innovations and lessons learned that are applicable (in their minds) to similar projects.
5. Society of Ecological Restoration's "Attributes of Restored Ecosystems" (Appendix N). Ask all District Managers to complete the survey for all projects from their district (sample survey below).

| Attribute ¹ | Score (1-5) ² | Comments |
|---|--------------------------|----------|
| Characteristic assemblage of species, including indigenous species to extent practicable ³ | | |
| All functional groups present for continued development along appropriate trajectory | | |
| Physical environment capable of sustaining reproducing populations of species necessary for community maintenance | | |
| Normal function for stage of ecological development, recognizing that character and functions may/should change with time | | |
| Suitably integrated into the landscape | | |
| Potential threats from surrounding landscape removed | | |
| Sufficiently resilient to endure normal periodic stress | | |
| Self-sustaining | | |

¹ Based on a subset of those defined by the Society for Ecological Restoration; see Appendix L.

² Scoring: 1=to little or no extent (~F); 2=to some extent (~D); 3=to a moderate extent (~C); 4=to a great extent (~B); 5=to a very great extent (~A); N/A= no basis for determination.

³ This first attribute is a combination of 1 and 2 from the Attributes of a Restored Ecosystem; see Appendix N.

X. Project Review

1. References. List the documents used to develop the data within the database. Any input provided verbally or in writing by the districts will also be documented.
2. Links. Includes any project-related web links.

ADDITIONAL INFORMATION: This technical note was prepared by David L. Price, Justin S. Gardner, Erynn E. Maynard, and Craig J. Fischenich, Environmental Laboratory, U.S. Army Engineer Research and Development Center. The study was conducted as an activity of the Ecosystem Management and Restoration Research Program (EMRRP). For information on EMRRP, please consult <http://el.erdcl.usace.army.mil/emrrp/emrrp.html> or contact the Program Manager, Glenn Rhett, at Glenn.G.Rhett@erdcl.usace.army.mil. This technical note should be cited as follows:

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Appendix A: Ecosystem Type

Ecosystem Type: (pick list)

- Estuarine
- Nontidal Wetland
- Reservoir/Lake
- Riverine
- Tidal Wetland
- Upland

Appendix B: Congressional Authority

Congressional Authority: (pick list)

- Coastal Wetland Planning, Protection and Restoration Act
- Columbia River Channel Improvement Project
- Comprehensive Everglades Restoration Program
- Missouri River Restoration Program
- Other (Specify)
- Puget Sound and Adjacent Waterways
- Puget Sound Near Shore
- Specific Authorization
- Upper Mississippi River Restoration – Environmental Management Program
- WRDA – Section 204
- WRDA – Section 206
- WRDA – Section 1135

Appendix C: Environmental Resource Issues

Environmental Resource Issues: (pick list – not exclusive)

- Biodiversity
- Contaminant Material
- Environmental Flows
- Erosion
- Fish and Wildlife Populations and Communities
- Fish Passage
- Habitat Loss and Fragmentation
- Invasive Species (List)
- Land Loss
- Native Plant Communities
- Other (Specify)
- Recreation
- Sediment Management
- Storm Water
- Threatened and Endangered Species (List)
- Tidal Exchange
- Water Quality

Appendix D: Resource Significance

Resource Significance: (check box and list)

- a. Institutional Recognition: Laws, plans or policy statements of public agencies, tribes, and private groups.
 - i. Level of Institutional Recognition
 - National: (See examples under Types of Institutional Recognition)
 - Regional: (CWPPRA, Chesapeake Bay Program, Gulf of Mexico Program, etc...)
 - State: (State Water Quality Regulations, State Fish and Wildlife Management Plans, etc....)
 - Local: (Local resource protection ordinances)
 - ii. Type of Institutional Recognition
 - Public Agency: Endangered Species Act, Wild and Scenic Rivers Act, Anadromous Fish Conservation Act, North American Waterfowl Management Plan, Coastal America, etc....
 - Private/Non-Profit: Institutional recognition by NGOs such as The Nature Conservancy, Ducks Unlimited, etc..., which often maintain lists and databases that identify significance of environmental resources.
 - Tribal
 - iii. List of Endangered/Threatened Species Impacted
- b. Public Recognition: Importance of a resource to the general public as expressed through formal and informal activities, such as membership in organizations, financial contributions, volunteer activities, and correspondence.
 - i. Type of Public Recognition
 - National
 - State/Regional
 - Local
 - Tribal
- c. Technical Recognition.
 - Resource Scarcity: relative abundance, rareness
 - Biodiversity: species richness, genetic variability
 - Changing Status and Trends: changes in occurrence, extent of change over time
 - Connectivity: habitat corridors, fragmentations, barriers
 - Limiting Habitat: habitats essential to species survival
 - Representativeness: exemplifies natural and/or undisturbed habitat

Appendix E: Dominant Land Use in Watershed

Watershed Context

a. Dominant Land Use in Watershed: (pick list – not exclusive)

- Agricultural Land
- Barren Land
- Forested Land
- Rangeland
- Urban or Built-up Land
- Water
- Wetland
- Other (Specify)

Appendix F: Partners (Includes Sponsor, Partners, and Stakeholders)

Partners: Select applicable agency types for each entry into each heading (Sponsor, Partners, and Stakeholders) from the list below:

- Academic
- Citizen Groups
- Federal
- Local
- NGOs
- Other (Specify)
- State
- Tribal

Project Sponsor

Project Partners

Project Stakeholders

Appendix G: Project Restoration Intents

Project Restoration Intents: (check box - not exclusive, definitions on subsequent pages)

- Aquatic Habitat Improvement
- Aquatic/Wetland Plant Management
- Bank/Shoreline Stabilization
- Beneficial Uses of Dredged Material
- Channel Reconfiguration
- Dam Removal/Retrofit
- Fish and Wildlife Management
- Fish Passage
- Floodplain/Tidal Reconnection
- Flow Modification
- Land Acquisition
- Land Creation/Restoration
- Riparian/Shoreline Management
- Sediment Control and Management
- Water Quality Management

| Table G1. Definitions of Project Restoration Intents | |
|---|--|
| Aquatic Habitat Improvement | Altering the structural complexity of an aquatic system to increase habitat availability and diversity for target organisms and provide breeding habitat and refuge from disturbances and predators. Includes restoration, enhancement, and improvement in the form of boulder clusters; weirs or sills; log, brush, or rock structures; etc. Applies to a diversity of aquatic habitats and ecosystems: stream/riverine, wetland, lake/reservoir, nearshore, and coastal/estuarine. |
| Aquatic/Wetland Plant Management | Practices that directly or indirectly alter native species distribution, abundance, and community composition. Direct practices include seeding, planting, and translocation of plant species and/or the removal of invasive species. Indirect practices include modifications to hydrology that indirectly enhance the aquatic or wetland plant community. |
| Bank/Shoreline Stabilization | Practices designed to reduce or eliminate erosion or slumping of bank and beach material into a river channel or open water. Includes the use of rocks, logs, and vegetation placed directly into the bank, either by planting or placement of live branch fragments. |
| Beneficial Uses of Dredged Material | Dredged material consists of mineral and organic matter excavated from a body of water, typically recently deposited sediment or native material excavated for navigation or flood conveyance. Beneficial uses of dredged material provide opportunities for habitat creation and restoration projects by utilizing material in an environmentally beneficial and cost-effective manner in comparison to other potential disposal options. |
| Channel Reconfiguration | Alteration of channel plan, form, or longitudinal profile and/or day-lighting, which is converting culverts and pipes to open channels. Includes stream meander restoration, wing deflectors, grade control measures, weirs, sills, and all in-channel structures. |
| Dam Removal/Retrofit | Removal of dams or weirs or modifications/retrofits to existing dams to reduce negative ecological impacts (e.g., construction of multi-level off-takes to ensure appropriate water release rates). |

| | |
|---------------------------------|--|
| Fish and Wildlife Management | Practices that directly alter native species distribution, abundance, and community composition through stocking and translocating of animal species and/or the removal of invasive/nuisance species. |
| Fish Passage | Removal of barriers to upstream-downstream migration of fishes. Includes the physical removal of barriers and the construction of alternate pathways. |
| Floodplain/Tidal Reconnection | Practices that increase flood frequency of floodplain and tidal flats or marshes and/or promote the flux of organisms and material between riverine/open water as well as floodplain/tidal flats or marshes. Includes water level control, maintenance of hydraulic connections, lowering of banks or tide gates, culvert modifications, etc. |
| Flow Modification | Practices that alter the timing and delivery of water quantity associated with releases from impoundments and constructed flow regulators. Includes flushing releases for habitat restoration and channel maintenance. |
| Land Acquisition | Practices that result in a lease or title to stream-side land for preservation or removal of impacting agents and/or facilitate future restoration projects. (Simple purchase and preservation to prevent potential future land conversion is insufficient for land acquisition.) |
| Land Creation/Restoration | Includes diversions that supply nutrients and sediments to near-shore areas subject to land loss. |
| Riparian/Shoreline Management | Revegetation of riparian zones and/or removal of exotic/invasive species. Includes livestock exclusion or management, fencing, riparian forest buffers, mowing, weed control, and floodplain planting. Excludes localized planting to only stabilize the bank. |
| Sediment Control and Management | Practices that decrease sediment deposition and accretion where they are changing the underlying geomorphology or habitat structure and function including dredging, partial/full channel closure structures, and gate well/culvert systems. |
| Water Quality Management | Practices that protect the existing water quality or change the chemical composition and/or suspended particulate load. Such practices include salinity control measures and sediment basins. Best management practices include: agriculture, forestland, and urban and stream-flow temperature management. Excludes urban run-off quantities. |

Appendix H: Project Planning Models

Project Planning Models: (pick list – not exclusive)

- Community Index Model
- Floristic Diversity Index
- Habitat Quality Index
- Habitat Suitability Index (multiple species)
- Habitat Suitability Index (single species)
- Hydraulic Model
- Hydrogeomorphic Index Model
- Hydrologic Model
- Index of Biotic Integrity
- Other (Specify)
- Sediment Model
- Wetland Value Assessment

List specific model used (text box):

- New
- Existing – Modified
- Existing – Unmodified

Template: Planning Model-MODEL NAME-(New; Existing-Modified; Existing-Unmodified)

Examples: Habitat Evaluation Procedure – Habitat Suitability Index (red-winged blackbird, clapper rail, wintering black duck, wintering lesser scaup, alewife, blueback herring, hard clam) (Existing-Unmodified); Wildlife Habitat Appraisal Guide – Habitat Suitability Index (great blue heron) (Existing-Modified)

Appendix I: Guiding Image/Reference State

Guiding Image/Reference State:

Guiding image/reference state types (check box - definitions on subsequent pages)

- Best Attainable Condition
- Historical Condition
- Least Disturbed Condition
- Minimally Disturbed Condition
- Other (Specify)
- Reference Condition Biological Integrity
- Reference Ecosystem/Site
- Virtual Reference

| Table H1. Guiding Image/Reference State Types | |
|--|--|
| Best Attainable Condition (BAC) | The condition representing the least amount of human disturbance in the current landscape context coupled with the use of best management practices for a period of time that is long enough for desired conditions to be established and sustained. |
| Historical Condition (HC) | A condition prior to a predetermined historical point in time to include: Pre-human (HCPS), Pre-Columbian (HCPC), Pre-Intensive Agriculture (HCPA), and Pre-Industrialization and Urbanization (HCPI). |
| Least Disturbed Condition (LDC) | A condition representing the least amount of human disturbance in the current landscape context. In other words, the best of what is left. |
| Minimally Disturbed Condition (MDC) | A condition representing the absence of local human disturbance, while recognizing that minimal disturbance may be present due to human activities affecting regional/global processes (e.g., climate change, deposition of atmospheric contaminants below threshold required to have measureable impact on an ecosystem, etc.). |
| Other (Specify) | Describe |
| Reference Condition Biological Integrity (RCBI) | A condition representing the absence of human disturbance at the local, regional, and global spatial scales. |
| Reference Ecosystem/Site | An existing ecosystem that can be utilized as an example of the anticipated outcome and/or output of the restoration project. |
| Virtual Reference | A composite site or system model based upon the assessment by subject matter experts, whose conceptual idea of the optimal performance of the ecosystem is the reference for the project and project performance. |

Appendix J: Restoration Practices

Restoration Practices: (pick list – not exclusive)

- Beach nourishment
- Bulkhead removal, modification
- Channel creation, rehabilitation, restoration, stabilization
- Coastal land creation, restoration
- Contaminant remediation, removal
- Coral reattachment, stabilization, or transplant
- Culvert addition, modification, removal, replacement
- Dam modification, removal, replacement
- Debris or fill removal
- Dike and levee breaching, construction, improvement, removal
- Disease control
- Dredging and excavation
- Fish and aquatic species passage or barrier installation, modification, removal
- Habitat development and improvement
- Impoundment construction and repair
- In-stream construction and repair
- Invasive species control, management, or removal
- Large woody debris placement
- Native plantings and revegetation – aquatic
- Native plantings and revegetation – terrestrial

- Nutrient and D.O. management
- Other (Specify)
- Oyster reef development, improvement
- Placement of dredged material
- Prescribed burn
- Sediment diversion
- Shore and erosion control structures
- Species reintroductions and translocating (animals)
- Storm water runoff control and management
- Stream channel rehabilitation or creation
- Tide gate alteration, installation, modification, removal or replacement
- Tile disablement
- Vegetation removal
- Water control structure installation, modification
- Weir construction, modification, removal

Appendix K: Sample Performance Table

| Table K1. Sample performance examples. | | |
|--|--------------------------------------|--------------------|
| Data Type | Metric/Unit | Performance Target |
| Biological | Aquatic vegetation bed (acres) | 3,250 acres |
| Chemical | D.O. (mg/l) | >5 mg/l |
| Geomorphic | Length of eroded levee (linear feet) | 0 linear feet |
| Hydrological | Upstream water flow (ft/sec) | 0.35 ft/sec |

Appendix L: District Review Protocol

District Survey Review Instructions: A Retrospective Database of Completed Corps Ecosystem Restoration Projects

Background

The Corps has completed well over 250 restoration projects under various authorities, many of which are notable for their beneficial impact on the Nation's natural resources and their innovation in applying various engineering features. However, information on the restoration approaches used and outcomes achieved is widely dispersed across the Corps and is not readily available for systematic evaluation.

To address this issue, Headquarters, USACE has requested compilation of a retrospective database of information on ecosystem restoration projects completed by the Corps. The primary objective of this project is to assess the physical and ecological outcomes of a variety of restoration projects and the performance of the techniques and practices applied. Notable innovations and outcomes will also be documented and. "Lessons learned" that can help improve

the performance and outcomes of future projects will be documented, to help make ecosystem restoration investments better informed by the best science.

To this end, information has been compiled for those projects completed within various districts based on documentation received from district offices. To help ensure accuracy and completeness of the database, please review and comment on the data compiled for each project following the guidelines described below.

Survey Review Instructions

As our District POC for this research effort, you should have received a link to a SharePoint site (<https://team.usace.army.mil/sites/ERDC-EL/PDT/ERProjects/default.aspx>) where you will find the following documents to assist you in this review:

1. District Survey Review Instructions (PDF)
2. One Database Report for each completed project (PDF)
3. One Survey Workbook for each completed project (Excel)
4. Retrospective Database Guidelines (PDF): Individual data fields are defined in more detail here, and were developed to help standardize data entry into the Retrospective Database.

Once on the SharePoint site, please locate and access your District folder. Each District folder contains a folder for each authorization type identified for your District. Each authorization folder contains a series of folders, one for each project entered into the Retrospective Database and a District Review folder. In each of the project folders you will find all documentation received for each of your District's projects. From the District Review folder, please download each Database Report and Survey Workbook for each project. The Retrospective Database Guidelines are provided for reference on background information and definitions of key terms in different fields of the database.

The database is labeled using Roman Numerals I-X and the numbers 1-52. The labeling convention is consistent throughout each document to assist you throughout the review process. In each Survey Workbook, please complete the *Cover Sheet–Background Information* for each project prior to beginning the review process. For each Category (I-VIII and X), please review the information provided for accuracy and completeness. Instructions for Category IX follow below. If the data provided need to be modified in any way, please indicate in the space provided. If a modification applies to one or more of the headings or subheadings within a category, please indicate the heading/subheading to be modified in column D, "Suggested Corrections and/or Comments."

For Category IX – DISTRICT PROJECT REVIEW:

- Section 46: Summarize the project outcomes observed by project personnel.
- Section 47: Provide an overall project success score "1–5" (1 = to little or no extent (~F); 2 = to some extent (~D); 3 = to a moderate extent (~C); 4 = to a great extent (~B); 5 = to a very great extent (~A); N/A = no basis for determination).
- Section 48: Provide an explanation of the overall score given in Section 47.

- Section 49: Discuss any notable innovations and/or lessons learned as a result of the project.
- Section 50: Complete the Society of Ecological Restoration's survey "Attributes of Restored Ecosystems" by scoring each statement "1 – 5" (1 = to little or no extent (~F); 2 = to some extent (~D); 3 = to a moderate extent (~C); 4 = to a great extent (~B); 5 = to a very great extent (~A); N/A = no basis for determination) and provide any comments in the space provided. For additional information about the "Attributes of Restored Ecosystems" survey, click on the title in Row 9 that is a hyperlink to the Society of Ecological Restoration's website, or [click here](#) to visit the website. Refer to the database guidelines, mentioned above, which provide a further explanation and instructions for completing this section.

When each project workbook has been reviewed and completed, simply save the workbook and send to Justin S. Gardner at justin.s.gardner@usace.army.mil. Your review and the information that you provide will help ensure the accuracy and reliability of the Retrospective Database. Your input is important and will be catalogued as a primary source of information, along with the project reports that were reviewed. Note that the database is still in draft form and will be reviewed by a technical editor prior to posting on the USACE Ecosystem Restoration Gateway. Please be sure to identify (and if available, supply) any source documents used to gather additional data and information input into the database so that we may expand our library of project documentation. Additionally, please let us know if there are any completed restoration projects for your district that are not included in this review.

Appendix M: Sample District Review Survey

Cover Sheet

| DISTRICT PROJECT REVIEW - Background Information | |
|--|--|
| PROJECT NAME: | |
| Reviewed By: | |
| Date Review Completed: | |
| Address: | |
| Address 2: | |
| City, State, Zip Code: | |
| Phone Number: | |

Section I

| DISTRICT PROJECT REVIEW - Database Review (I) | | | |
|---|--------------------------|-----------------------------------|---------------------------------------|
| | | | |
| I | General Information | Correct? (Yes; No; Unknown) | Suggested Corrections and/or Comments |
| 1 | Ecosystem Type: | | |
| 2 | Congressional Authority: | | |
| 3 | P2 number: | | |
| 4 | Location: | | |
| 5 | Project size: | | |
| 6 | Project cost: | | |
| 7 | Timeline: | | |
| 8 | Corps point of contact: | | |
| | | | |

Section II

| DISTRICT PROJECT REVIEW - Database Review (II) | | | |
|--|--------------------------------|-----------------------------------|---------------------------------------|
| | | | |
| II | Project Overview | Correct? (Yes; No; Unknown) | Suggested Corrections and/or Comments |
| 9 | Project Purpose: | | |
| 10 | Problem Description: | | |
| 11 | Environmental Resource Issues: | | |
| 12 | Project Site Description: | | |
| 13 | Project Features: | | |
| 14 | Resource Significance: | | |
| 15 | Watershed Context: | | |
| | | | |

Section III

| DISTRICT PROJECT REVIEW - Database Review (III) | | | |
|---|-----------------------|-----------------------------|---------------------------------------|
| III | Partners | Correct? (Yes; No; Unknown) | Suggested Corrections and/or Comments |
| 16 | Project Sponsor: | | |
| 17 | Project Partners: | | |
| 18 | Project Stakeholders: | | |

Section IV

| DISTRICT PROJECT REVIEW - Database Review (IV) | | | |
|--|--------------------------------|-----------------------------|---------------------------------------|
| IV | Project Planning | Correct? (Yes; No; Unknown) | Suggested Corrections and/or Comments |
| 19 | Restoration Intent: | | |
| 20 | Planning Constraints: | | |
| 21 | Conceptual Model Prepared: | | |
| 22 | Planning Model Types Used: | | |
| 23 | Guiding Image/Reference State: | | |
| 24 | Project Work Group Utilized: | | |

Section V

| DISTRICT PROJECT REVIEW - Database Review (V) | | | |
|---|--|-----------------------------|---------------------------------------|
| V | Restoration Measures and Engineering | Correct? (Yes; No; Unknown) | Suggested Corrections and/or Comments |
| 25 | Restoration Practices Employed: | | |
| 26 | Describe Notable Project Engineering And Design Issues Or Constraints: | | |
| 27 | Implemented As Planned And Designed: | | |

Section VI

| DISTRICT PROJECT REVIEW - Database Review (VI) | | | |
|--|--|-----------------------------------|---------------------------------------|
| VI | Monitoring | Correct? (Yes; No; Unknown) | Suggested Corrections and/or Comments |
| 28 | Is there a monitoring plan? | | |
| 29 | QA/QC plan: | | |
| 30 | Is there a monitoring report? | | |
| 31 | Are monitoring data available? | | |
| 32 | Number of site visits post-construction/implementation: | | |
| 33 | Identify and describe monitoring constraints: | | |
| 34 | Have there been any changes to the monitoring plan or program? | | |
| 35 | Performance table: | | |

Section VII

| DISTRICT PROJECT REVIEW - Database Review (VII) | | | |
|---|---|-----------------------------------|---------------------------------------|
| VII | Evaluation | Correct? (Yes; No; Unknown) | Suggested Corrections and/or Comments |
| 36 | Anticipated benefits/success criteria: | | |
| 37 | Are quantitative success criteria identified? | | |
| 38 | Was the project successful in achieving goals/success criteria? | | |

Section VIII

| DISTRICT PROJECT REVIEW - Database Review (VIII) | | | |
|--|--|-----------------------------------|---------------------------------------|
| VIII | Adaptive Management | Correct? (Yes; No; Unknown) | Suggested Corrections and/or Comments |
| 39 | Was an Adaptive Management Plan prepared? | | |
| 40 | Was an Operation and Maintenance Manual prepared? | | |
| 41 | Major elements of uncertainty in the project: | | |
| 42 | Are monitoring results intended to assess project performance? | | |
| 43 | Have there been post-implementation modifications to the project features? | | |
| 44 | Who does maintenance and adaptive management? | | |
| 45 | Notable innovations and lessons learned: | | |

Section IX

| DISTRICT PROJECT REVIEW - Database Review (IX) | | | |
|--|---|--|-------------------------|
| IX | District Project Review | Numerical *Scores* (when requested) | Answers and/or Comments |
| 46 | Project outcomes: | N/A | |
| 47 | *Score* overall project success: | | N/A |
| 48 | Explain overall score: | N/A | |
| 49 | Notable innovations and lessons learned: | N/A | |
| 50 | Society of Ecological Restoration's "Attributes of Restored Ecosystems" (Modified) - Website Link | | |
| | Attribute | *Score* | Comments |
| | Characteristic assemblage of species, including indigenous species to extent practicable | | |

| | | |
|--|--|--|
| All functional groups present for continued development along appropriate trajectory | | |
| Physical environment capable of sustaining reproducing populations of species necessary for community maintenance | | |
| Normal function for stage of ecological development, recognizing that character and functions may/should change with time | | |
| Suitability integrated into the landscape | | |
| Potential threats from surrounding landscape removed | | |
| Sufficiently resilient to endure normal periodic stress | | |
| Self-sustaining | | |
| *Score from 1 to 5 : (1=to little or no extent (~F); 2=to some extent (~D); 3=to a moderate extent (~C); 4=to a great extent (~B); 5=to a very great extent (~A); N/A – no basis for determination)* | | |

Section X

| DISTRICT PROJECT REVIEW - Database Review (X) | | | |
|---|----------------|-----------------------------|---|
| X | Project Review | Correct? (Yes; No; Unknown) | Additional References or Links not included |
| 51 | References | | |
| 52 | Links | | |

Appendix N: Attributes of Restored Ecosystems

1. Attributes of Restored Ecosystems: (from the Society for Ecological Restoration) http://www.ser.org/content/ecological_restoration_primer.asp
 - a. The restored ecosystem contains a characteristic assemblage of the species that occur in the reference ecosystem and that provide appropriate community structure. (This attribute is combined with #2 for use in the scoring table on page 9.)

- b. The restored ecosystem consists of indigenous species to the greatest practicable extent. In restored cultural ecosystems, allowances can be made for exotic domesticated species and for non-invasive ruderal and segetal species that presumably co-evolved with them. Ruderals are plants that colonize disturbed sites, whereas segetals typically grow intermixed with crop species. (This attribute is combined with #1 for use in the scoring table on page 9.)
- c. All functional groups necessary for the continued development and/or stability of the restored ecosystem are represented or, if they are not, the missing groups have the potential to colonize by natural means.
- d. The physical environment of the restored ecosystem is capable of sustaining reproducing populations of the species necessary for its continued stability or development along the desired trajectory.
- e. The restored ecosystem apparently functions normally for its ecological stage of development, and signs of dysfunction are absent.
- f. The restored ecosystem is suitably integrated into a larger ecological matrix or landscape, with which it interacts through abiotic and biotic flows and exchanges.
- g. Potential threats to the health and integrity of the restored ecosystem from the surrounding landscape have been eliminated or reduced as much as possible.
- h. The restored ecosystem is sufficiently resilient to endure the normal periodic stress events in the local environment that serve to maintain the integrity of the ecosystem.
- i. The restored ecosystem is self-sustaining to the same degree as its reference ecosystem, and has the potential to persist indefinitely under existing environmental conditions. Nevertheless, aspects of its biodiversity, structure, and functioning may change as part of normal ecosystem development, and may fluctuate in response to normal periodic stress and occasional disturbance events of greater consequence. As in any intact ecosystem, the species composition and other attributes of a restored ecosystem may evolve as environmental conditions change.

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